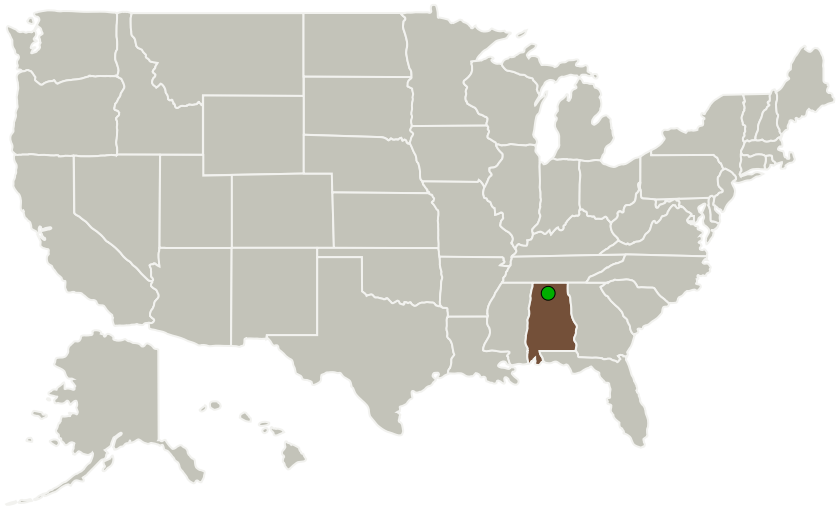
Efficient Conversion of Carbon Dioxide into Methane using 3rd Generation Ionic Liquids, Phase I

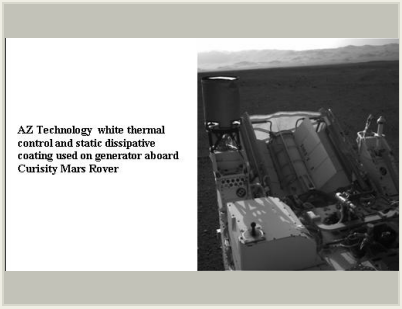
Completed Technology Project (2013 - 2013)

Project Introduction

This work directly addresses a technology of interest listed in Section 9, sub-section H1.01 In-Situ Resource Utilization, specifically "Highly efficient reactors for carbon monoxide/carbon dioxide (CO/CO2) conversion into methane (CH4)." The proposal will investigate combining recent work that demonstrates outstanding CO2 sorption by third generation ionic liquids (ILs) without an increase in viscosity (even in the presence of water) with adaptations of recently developed methodology for electrochemically reducing and polymerizing CO2 in an aqueous IL to polyethylene. The intention is to demonstrate that this methodology is an excellent candidate for creating a highly efficient reactor for carbon dioxide conversion to methane. Unlike conventional electrolytes, ILs generally have very low vapor pressures. This will make it possible for them to be used in the much lower pressure Martian atmosphere without the problem of evaporation. Our goal is to build on the results achieved by other research groups by using our own knowledge and years of experience working with ILs, including electrochemistry, to efficiently reduce CO2. We will prepare the task-specific 3rd generation ILs and then measure their electrochemical properties; i.e., conductivity, electrochemical window, etc. These are currently unknown but are important in order to ascertain whether these ILs are suitable for this application. Anticipating this will be the case, we will then test various electrodes, including TiO2 and silver cathodes, to determine which gives the most selective reduction of CO2 to methane. The efficiency of the process (including power requirements) will be quantified and compared to the Sebatier and Fischer-Tropsch processes.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
AZ Technology, Inc.	Lead Organization	Industry Veteran-Owned Small Business (VOSB), Women-Owned Small Business (WOSB)	Huntsville, Alabama
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations
Alabama

Project Transitions

May 2013: Project Start

November 2013: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138114)*

Images

Project Image
Efficient Conversion of Carbon Dioxide into Methane using 3rd Generation Ionic Liquids
(https://techport.nasa.gov/image/134082)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
AZ Technology, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

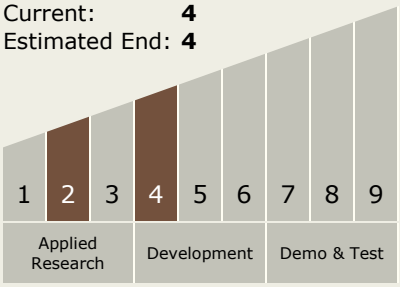
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Mark S Paley

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.3 Resource Processing for Production of Mission Consumables

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System